MAR 26 1999

MEMORANDUM FOR: Robert S. Winokur
Acting System Program Director
NPOESS Integrated Program Office

FROM: Judith J. Gordon
Assistant Inspector General for Systems Evaluation
Office of Inspector General
Department of Commerce

Russell A. Rau
Assistant Inspector General for Auditing
Office of Inspector General
National Aeronautics and Space Administration

SUBJECT: Inspection Report, *Proposed NPOESS Preparatory Project Reduces Operational Risk, But Excludes Demonstration of Critical Ozone Suite* (DOC OSE-11103/NASA IG-99-012)

The Offices of Inspector General of the Department of Commerce and National Aeronautics and Space Administration (NASA) conducted a joint inspection of the risks and costs associated with technology transfer to the National Polar-orbiting Operational Environmental Satellite System (NPOESS). This inspection report identifies a risk reduction issue concerning a proposed joint NPOESS Integrated Program Office (IPO)/NASA NPOESS Preparatory Project (NPP) mission that warrants your immediate attention.

We found that preliminary planning assumptions for the proposed NPP do not include evaluating the feasibility of demonstrating the Ozone Mapper Profiler Suite (OMPS), one of IPO's critical sensors. Exclusion of OMPS from flight demonstration will significantly increase the risk of a disruption in vital ozone data continuity. We recommend that IPO (1) request NASA to include OMPS as a payload alternative in its NPP feasibility study, (2) defer the decision to include or exclude OMPS for flight demonstration until mission costs are fully analyzed and a cost sharing arrangement is negotiated, and (3) assess the operational risk of not demonstrating OMPS.

Your response indicates general concurrence with the recommendations and that implementing actions have been taken or planned. We have included on page 7 a synopsis of your general comments on the report findings, and a synopsis of your response to each recommendation followed by an OIG discussion. Your response in its entirety is included as Appendix A.

We appreciate the cooperation of IPO and agency staff during this inspection.

BACKGROUND

The Department of Commerce, Department of Defense, and NASA are developing NPOESS in accordance with a 1994 Presidential Decision Directive. The Directive calls for NPOESS to combine the separate DOD Defense Meteorological Satellite Program (DMSP) and the Commerce/NASA-supported, Polar-orbiting Operational Environmental Satellite (POES) programs into a single, jointly operated satellite system. An Executive Committee (EXCOM), consisting of the Under Secretary of Commerce for Oceans and Atmosphere, Under Secretary of Defense for Acquisition and Technology, and NASA Deputy Administrator is responsible for policy guidance. Program implementation is the responsibility of IPO, under the direction of a Commerce system program director.

The acquisition strategy developed in 1996 includes early development of five critical sensors, which are characterized by significant technological challenge: (1) Visible/Infrared Imager Radiometer Suite (VIIRS), (2) Conical Microwave Imager Suite (CMIS), (3) Cross-track Infrared Sounder (CrIS), (4) Ozone Mapper Profiler Suite (OMPS), and (5) Global Positioning System Occultation Sensor (GPSOS).

Until 1998, critical sensor risk reduction activities included a flight demonstration of CrIS, OMPS, and GPSOS by adding these sensors to POES-N Prime, NOAA's last polar-orbiting operational satellite before convergence with NPOESS. However, an increase in the estimated cost, IPO budget cuts, and concern about NASA's Earth Observing System (EOS) mission continuity prompted IPO and NASA to develop an alternative mission. The alternative—NPP—would combine demonstration of NPOESS critical sensors with a developmental payload in support of NASA's Earth Science Program/EOS. NASA formally initiated an NPP feasibility study in September 1998 and is preparing a mission development plan. The plan will be completed in March 1999, and will define technical content, agency roles, budget, and cost sharing. EXCOM endorsed the NPP feasibility study at its December 18, 1998, meeting and is scheduled to consider the study results when it meets in April 1999.

PURPOSE AND SCOPE OF INSPECTION

The purpose of our review was to assess the level of sensor technology being transferred from NASA and other sources to NPOESS to minimize risk and cost. Although we are continuing our work in this area, this report is being submitted at this point because of the immediate need for IPO to deal with our observations and recommendations. The observations and recommendations contained in this report focus specifically on the risk and cost effects that changes in the methodology for demonstrating selected critical sensors may have on the mission success of NPOESS technology.

The scope of our work included evaluating the technology transfer roles and responsibilities of IPO and NASA, IPO planning and coordination with NASA, and management controls. We interviewed IPO technology transition and critical sensor engineers and project managers and representatives from NASA's Earth Science Program with responsibility for EOS satellites. We also interviewed NASA and Commerce research and operations scientists.

Our work was performed in accordance with the Inspector General Act of 1978, as amended, and the *Quality Standards for Inspections,* March 1993, issued by the President's Council on Integrity and Efficiency.

OBSERVATIONS AND CONCLUSIONS

Proposed NPP Reduces Operational Risk, But Excludes Critical Ozone Suite

We endorse the concept of converging NPOESS risk reduction demonstrations with a NASA mission. Under the proposed NPP, the flight demonstration of NPOESS critical sensors would no longer be tied to the POES-N Prime satellite, lowering the risk of operational failure due to the satellite modifications that would be required to add NPOESS sensors. However, one of IPO's critical sensors planned for demonstration on POES-N Prime, OMPS, is excluded in the preliminary NPP flight planning assumptions due to actual and anticipated budget cuts. Without flight demonstration of OMPS, the risk is significantly increased that sufficient ozone data may not be available to support federal government decision-making on actions to reduce ozone depletion.

High Risk Ozone Sensor Suite Not Considered for Feasibility/Cost Study

The NPP mission initial planning assumptions outlined in NASA's Associate Administrator for Earth Science memorandum of September 17, 1998, do not include OMPS. NASA's subsequent Mission Concept and Development Plan for its study of the NPP mission feasibility and system concept does not include OMPS as a primary alternative, but rather a possible consideration along with a NASA research sensor, meaning that its life-cycle costs will not be analyzed. OMPS should be included as a primary alternative due to its development risk and the potential for a gap in high quality ozone data.

OMPS was chosen for flight demonstration on POES-N Prime to mitigate its potential high development risk and to provide users with better ozone data prior to the first NPOESS. OMPS is a high risk sensor because it combines functions previously performed by two sensors and significantly advances the technology. It will perform the functions of both Commerce's Solar Backscatter Ultraviolet Spectral Radiometer (SBUV), flown on POES satellites, and NASA's Total Ozone Mapper Sensor (TOMS), flown on the Earth Probe satellite. OMPS will also

advance the SBUV and TOMS 1970s technology and obtain significantly better data to increase the usefulness of ozone monitoring products.

According to IPO's Cost Analysis Requirements Description (which establishes size, weight and power margins [risk factors] for the five critical sensors), VIIRS, CrIS, and OMPS carry the highest degree of development uncertainty. A flight demonstration would provide for early evaluation of sensor and algorithm capabilities and corrective modifications if needed before the first NPOESS launch. VIIRS and CrIS are proposed for demonstration on the NPP mission based on the inherent risks of flying new, complex technology for the first time.

Flight demonstration of OMPS was justified in the IPO budget beginning in fiscal year 1998. The justification cited the need for new technology to meet ozone data user requirements. According to IPO's Single Acquisition Management Plan, OMPS is critical in determining high resolution ozone profiles and related trace gases, which are vital to monitoring changes in the composition of the atmosphere and deducing the effects of these changes on the global climate. According to Commerce and NASA ozone scientists, to be highly effective, ozone instruments must accurately measure a vertical profile and be able to map a horizontal column within the stratosphere and troposphere. Current ozone sensors do not provide the high resolution data sets that are needed in profiling and mapping to examine small scale ozone phenomenon and improve data models and products. Demonstration of OMPS prior to the first NPOESS would provide a phased introduction of NPOESS-like capabilities to meet the users' highest priority needs while mitigating NPOESS development risk.

Commerce and NASA Are Required to Monitor and Report on the Extent and Effect of Ozone Depletion

Eliminating flight demonstration of OMPS may jeopardize the ability of the federal government to meet public safety and international agreement responsibilities. Commerce and NASA are mandated to monitor ozone levels, conduct research, and report on the levels of ozone depletion. Under the Clean Air Act of 1990, Public Law 101-549, Commerce's National Oceanic and Atmospheric Administration and NASA are responsible for monitoring and reporting on the condition of the earth's ozone because of the adverse effects that have been linked to ozone depletion. Health hazards that have been associated with ozone depletion include skin cancers, suppression of the immune system, gene mutations, eye disorders including cataracts, as well as adverse effects on crops, animals and marine life.

Under the National Aeronautics and Space Administration Authorization Act, Public Law 94-39, NASA is responsible for conducting scientific research of the upper atmosphere, including assessing long-term environmental change. Both Commerce and NASA are required to report to Congress on the status of ozone depletion. Congress and the President need reliable information

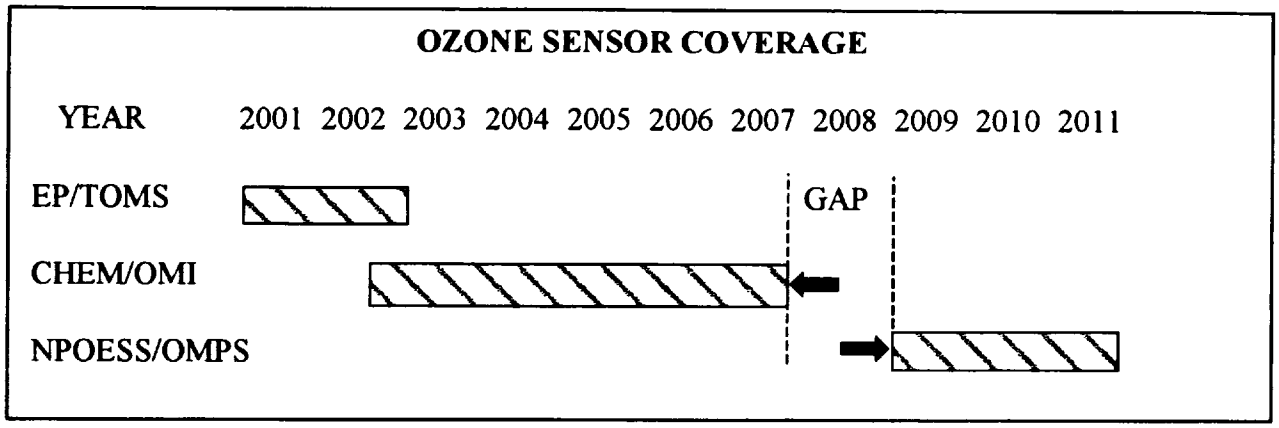
on ozone status, changes, and causes to make policy decisions on actions to reduce ozone depletion. Ozone information is also needed to ensure compliance with the Montreal Protocol, an international agreement to eliminate ozone-depleting substances. Should OMPS high quality ozone data not be available, Commerce and NASA may not be able to effectively support federal government policy decision-making.

Eliminating OMPS Demonstration Testing Will Significantly Increase Risk of a Disruption in Vital Ozone Data Continuity

Excluding a flight demonstration of OMPS increases the risk of a disruption in high quality ozone data in two ways. First, the risk is increased by the possibility of an OMPS failure on the first NPOESS. OMPS was planned for flight demonstration on POES-N Prime in 2008, with nearly a four-year satellite life expectancy. If OMPS were demonstrated on NPP instead, it would launch in mid-2005 with a five-year life. Without demonstration on either platform, the first flight will be on NPOESS in early 2009. If OMPS fails on NPOESS, the satellite will not be replaced. According to IPO, an on-orbit satellite will be replaced only if specific weather data gathering sensors—not including OMPS— fail. Since the next NPOESS is not scheduled to launch until 2011, an early OMPS failure on the first NPOESS would result in Commerce and NASA not having critical ozone data for two years.

Second, the risk is increased due to the expected termination of NASA missions and the potential for a delay in launching the first NPOESS. The TOMS mission is expected to end in 2003. NASA's Ozone Mapping Instrument (OMI) is scheduled to launch on NASA's EOS CHEM-1 satellite in 2002. This sensor is to provide high quality ozone data to NASA and Commerce and to continue NASA's ozone data gathering until OMPS is available. However, the OMI design life is five years, resulting in expected mission termination in 2007. This may result in a gap in coverage for more than a year until the first NPOESS is operational in 2009. The gap could be larger if the first NPOESS launch date slips. The first launch has already been delayed from 2004 to 2009, primarily due to DMSP and POES satellites lasting longer than expected, and could be further delayed (see Table 1 on page 6).

Table 1. Potential Gap in Ozone Coverage



Uncertainties Require Further Alternatives and Cost Analysis

According to IPO, POES-N Prime sensor demonstrations will not be performed because its budget will no longer support the required satellite modifications. IPO decided also that its budget will not support flight of OMPS at the time of the NPP mission. IPO based its budget for the demonstration of CrIS, OMPS, and GPSOS aboard POES-N Prime on a one-month limited scope accommodation study it tasked NASA to perform in 1996; however, design assumptions about CrIS significantly changed since the study was completed. A detailed, 10-month NASA study using more current information was completed August 17, 1998. The second study showed that the flight demonstration would cost $148 million, more than double the $65 million 1996 estimate used for NPOESS budgeting.

IPO and NASA formally discussed an alternative flight demonstration—NPP—on August 27, 1998. However, OMPS was excluded based on IPO priorities and resource assumptions. OMPS was considered less important to Commerce than sensors that support weather forecasting, and the NPOESS faced a Congressional $14.7 million Commerce fiscal year 1999 budget cut and another $15.5 million OMB fiscal year 2000 cut. According to IPO, these budget cuts force a slowdown in OMPS delivery from mid-2002 to early 2005—too late for inclusion on the NPP mission. The IPO estimated that it would cost about $14 million to maintain the 2002 delivery date to support inclusion in NPP.

The IPO decision that it lacked sufficient funding to fly OMPS may be premature. Because Congress reduced the Commerce fiscal year 1999 appropriation, it appeared likely that the Defense appropriation would also be reduced due to its joint funding arrangement with Commerce. However, IPO learned in December 1998 that it may receive $14.7 million

unanticipated funding from Defense. The $14.7 million would be enough to resume the 2002 OMPS delivery schedule.

The decision to exclude OMPS is also premature because it was made before IPO knew its cost share of the mission. IPO could not provide support for the cost projections used in its decision to exclude OMPS from the NPP mission. NASA's Associate Administrator for Earth Science directed full life-cycle cost analysis of alternatives to be included in the NPP Mission Concept and Development Plan study, including cost sharing. Only if OMPS is included in the study will the complete budget implications of including OMPS be known, allowing an informed decision to be made. Considering the high risk that quality ozone data may not be available to meet national needs without a flight demonstration, OMPS should be given further consideration.

IPO General Comments on Findings and OIG Discussion

IPO expressed concern about language in the report suggesting that the NPOESS program should be responsible for ensuring continuity of global ozone mapping data, and commented that it is currently a NASA responsibility. We found that Public Law 101-549 makes Commerce and NASA equally responsible for monitoring and reporting on the condition of the earth's ozone.

We reported that IPO was receiving $14.7 million unanticipated funding from Defense and that this amount would be enough to resume the 2002 OMPS delivery schedule. IPO responded that the statement was not accurate because the $14.7 million was originally anticipated as a critical part of full funding for NPOESS in fiscal year 1999 (and thus, not unanticipated), and was already earmarked for other activities. The issue is not the meaning of "unanticipated funding," but whether IPO should use the $14.7 million from Defense for OMPS or the other activities. IPO should decide how best to use its resources for the NPOESS mission. The intent of this report is to encourage IPO to fully analyze risks and costs as a means of establishing priorities.

RECOMMENDATIONS

We recommend that the Acting System Program Director:

1. Request NASA to include OMPS as a payload alternative in the NPOESS Preparatory Project Mission Concept and Development Plan study.

   Synopsis of IPO's Response

   IPO accepts this recommendation. The Assistant Administrator for Satellite and Information Services (also the IPO Acting System Program Director) and the NASA Associate Administrator for Earth Science, have directed the joint IPO/NASA NPP

planning team to include OMPS as a fourth payload alternative in the NPP mission concept and development plan study. NASA recently released a Request for Information (RFI) to solicit proposals from industry to implement a spacecraft for the proposed NPP mission. The RFI includes mass, power, and data rate specifications for a fourth, instrument-of-opportunity payload on NPP. The planning team will conduct a complete assessment to determine if a fourth payload, such as OMPS, can be accommodated on NPP within agency cost constraints.

OIG Discussion

IPO's actions are responsive to the recommendation.

2. Defer the decision to include or exclude OMPS for the NPP flight demonstration until mission costs are fully analyzed and a cost sharing arrangement is negotiated.

Synopsis of IPO's Response

IPO accepts this recommendation. A decision on whether a fourth payload can be accommodated on NPP at an affordable program cost, and if so, the selected payload, will be deferred until NPP mission costs are fully analyzed, IPO and NASA program priorities for NPP are approved by EXCOM and NASA Headquarters respectively, and an equitable cost sharing arrangement between IPO and NASA has been negotiated. IPO expects to brief EXCOM on the NPP study status in the spring of 1999.

Adding a fourth sensor, such as OMPS, to NPP will increase the mass, power, attitude control, command and control, and data transmission requirements placed on the proposed spacecraft. The potential risk is that the NPP mission may not be affordable even with joint IPO/NASA funding if the spacecraft must be sized and configured to carry four payloads. If a decision is made to carry OMPS as a fourth payload on NPP, then additional funding in the FY 2001 – FY 2004 NOAA budget for NPOESS will be required to accelerate the OMPS instrument fabrication schedule to meet an earlier delivery date for NPP spacecraft integration.

OIG Discussion

IPO's actions are responsive to the recommendation. However, it is too early to determine whether additional funding will be needed. When the NPP concept and development plan in completed, IPO will be in a better position to prioritize an OMPS demonstration in relation to other NPOESS mission activities based on mission risks and costs and a cost sharing arrangement with NASA.

3. Assess the operational risk of not demonstrating OMPS.

Synopsis of IPO's Response

IPO accepts this recommendation. Based on a preliminary assessment of information and documentation received from contractors, IPO believes that instrument designs are mature enough to be able to accept the potential risk of not conducting a space-based test of the specific OMPS instrument prior to the first operational NPOESS launch, if OMPS cannot be accommodated on the NPP mission.

The global ozone mapping component of OMPS will be derived from the TOMS instrument, a proven space-based, remote sensing technology, as well as the improved technologies that will be demonstrated by NASA's OMI on the CHEM-1 mission beginning in 2002. The OMPS will also include a limb sensor to improve the vertical resolution in atmospheric ozone profile measurements, rather than a nadir-pointing sensor as used on the POES SBUV. Although this specific sensor has not yet flown operationally, research ozone limb sensors will be demonstrated by NASA over the next several years. These missions will provide valuable risk reduction information to IPO and its contractors.

To ensure that a gap in global ozone mapping does not occur, IPO believes that NASA, NOAA and their international partners should periodically assess the status of space-based ozone measurements and determine methods to maintain a long-term ozone data record. IPO will provide a more complete assessment of the potential operational risks of not demonstrating OMPS to the OIGs in May 1999, after it has completed source selection and awarded a single contract for development and fabrication of OMPS.

OIG Discussion

IPO's actions are responsive to the recommendation.

IPO's full response is included as Appendix A.

Appendix A

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
CHIEF FINANCIAL OFFICER/CHIEF ADMINISTRATIVE OFFICER

MAR 16 1999

MEMORANDUM FOR: Johnnie Frazier
Acting Inspector General

FROM: Paul F. Roberts

SUBJECT: OIG Draft Inspection Report: Proposed NPOESS Preparatory Project Reduces Operational Risk, But Excludes Demonstration of Critical Ozone Suite (DOC OSE-1103/NASA P&A-98-008)

Thank you for the opportunity to review and comment on the draft inspection report on risk reduction efforts for technology associated with the National Polar-orbiting Operational Environmental Satellite System (NPOESS). The NPOESS Preparatory Project (NPP), a joint project of the Integrated Program Office (IPO) of the National Environmental Satellite, Data, and Information Service and the National Aeronautics and Space Administration (NASA), is a major part of those efforts.

In general, we agree with the findings in the draft report regarding the proposed risk reduction, early flight of opportunity demonstration program that the IPO and NASA's Office of Earth Science (OES) is jointly pursuing. NOAA is particularly pleased that the Office of Inspector General (OIG) has endorsed and independently validated the concept of the NPP mission. We believe that this joint mission will provide an early flight of opportunity demonstration to reduce risk to the critical NPOESS sensors that will be flown operationally beginning in late 2008, as well as allow NASA to ensure continuity of selected earth science data sets between the anticipated end of NASA's Earth Observing System (EOS) AM and PM missions in 2005-2006 and the start of the NPOESS mission in 2008.

We agree with the recommendations made in the report concerning the Ozone Mapping and Profiler Suite (OMPS) and we have already taken action on the recommendations to include the OMPS as a payload alternative in the NPP feasibility study and to defer the decision to include or exclude OMPS on NPP until

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the mission costs are analyzed completely and a cost sharing agreement between the IPO and NASA has been negotiated. In addition, we are in agreement with the OIG about ensuring continuity of global ozone mapping data during the transition (2007-2008) from the NASA ozone mapping research missions to the operational NPOESS mission. Those issues are addressed in our general comments on findings.

We have made a preliminary evaluation of the potential operational risks of not demonstrating OMPS prior to the first NPOESS launch, but will defer a more complete assessment until May 1999, after the IPO has completed source selection and has awarded a single contract for development and fabrication of the OMPS.

Again, NOAA appreciates the opportunity to and comment on the draft inspection report. Our specific response to each finding and recommendation is attached.

Attachment

Comments on Findings and Responses to Recommendations: OIG Draft Inspection Report "Proposed NPOESS Preparatory Project Reduces Operational Risk, But Excludes Demonstration of Critical Ozone Suite"

Section I: General Comments on Findings

We are pleased that the OIG has endorsed and independently validated the concept of converging NPOESS risk reduction, early flight demonstrations with a NASA mission. We believe that this joint mission will provide an important opportunity to reduce risk to the critical NPOESS sensors that will be flown operationally beginning in late 2008, as well as allow NASA to ensure continuity of selected earth science data sets between the anticipated end of NASA's Earth Observing System (EOS) AM and PM missions in 2005-2007 and the start of the NPOESS mission in 2008.

The OIG review of the proposed NPP mission identified that the Ozone Mapping and Profiler Suite (OMPS) that is planned for NPOESS was not specifically included as a payload alternative in the initial planning assumptions for the NPP mission. As a result, the OIG concluded that, "Exclusion of OMPS from flight demonstration will significantly increase the risk of a disruption in vital ozone data continuity." Although we understand the OIG's interest in ensuring continuity of global ozone mapping data to support federal government policy decision-making, we are concerned about the suggestion that the OIG has made that the NPOESS program should be responsible for ensuring continuity of global ozone mapping data during the transition (2007-2008) from the NASA ozone mapping research missions to the operational NPOESS mission.

Global ozone mapping is currently a NASA responsibility that is accomplished through their Total Ozone Mapping Spectrometer (TOMS) research mission. Beginning in late 2002 and extending into 2007, NASA will continue its long-term ozone mapping research when an Ozone Monitoring Instrument (OMI) is launched on the EOS Chemistry (CHEM) mission. Complementary atmospheric ozone profile data will be acquired from the nadir-pointing Solar Backscatter Ultraviolet Radiometer/2 (SBUV/2) on the National Oceanic and Atmospheric Administration's (NOAA) Polar-orbiting Operational Environmental Satellites (POES) during this same time period. We are prepared to assume full operational responsibility for global ozone mapping and profiling using the OMPS, when the first NPOESS spacecraft is launched in late 2008. To ensure that a gap in global ozone mapping does not occur in 2007-2008, as the OIG suggests, we believe that NASA, NOAA, and

other international partners should periodically assess the status of space-based ozone measurements and determine methods to maintain the long-term ozone data record utilizing both space-based and *in situ* observations. This approach will be especially important if the OMPS cannot be accommodated on the NPP mission because of cost considerations and agency priorities.

Finding I: Proposed NPP Reduces Operational Risk, But Excludes Critical Ozone Suite

The IPO agrees with the comments in the draft report concerning the NPOESS Preparatory Project. The NPP mission concept has been developed jointly with NASA to provide the IPO with a demonstration and validation for three (3) of the four (4) critical NPOESS instruments and to provide NASA with continuation of selected, calibrated, validated, and geo-located global imaging and sounding observations after the EOS AM and PM missions and prior to the NPOESS mission.

A: High Risk Ozone Sensor Suite Not Considered for Feasibility/Cost Study

The NPOESS Optimized Convergence Plan initiated in FY 1997 included a risk reduction component to demonstrate selected instruments on an early flight of opportunity. Those instruments included the critical Cross-track Infrared Sounder (CrIS), as well as the Global Positioning System Occultation Sensor (GPSOS) and the OMPS, which are high priority NPOESS sensors. At the time that the Optimized Convergence Plan was formulated, the only spacecraft that was expected to be available for an early flight demonstration was POES-N', the last operational satellite in the POES series. Because of the existing constraints of POES-N', the only planned NPOESS instruments that could possibly be accommodated on the spacecraft were CrIS, GPSOS, and OMPS. The IPO proceeded with feasibility studies for this risk reduction demonstration, even though it would require modifications to an operational satellite and would potentially increase the risk of operational failure of POES-N'. If the opportunity to use a separate, unencumbered, non-operational satellite for an early flight demonstration had been apparent in FY 1997, the IPO would have planned to demonstrate the four critical NPOESS instruments: Visible/Infrared Imager Radiometer Suite (VIIRS); Cross-track Infrared Sounder (CrIS); an advanced cross-track microwave sounder (currently the Advanced Technology Microwave Sounder [ATMS] being developed by NASA for NPOESS); and the Conical-scanning Microwave Imager/Sounder (CMIS). We have been able to leverage other satellite programs to reduce potential development and operational risks for the CMIS

sensor. Through a separate joint program with the Department of Defense (DOD), the IPO has been supporting the WindSat/Coriolis mission that, beginning in late 2001, will provide a space-based demonstration of the passive microwave radiometric measurement technologies that will be incorporated into CMIS.

As the OIG report correctly states on page 6, a detailed NASA study of the modifications to the POES-N' spacecraft that would be required to accommodate CrIS, GPSOS, and OMPS was completed in mid-August 1998 and showed that the costs ($148 million) would be more than double the original estimate ($65 million) used for NPOESS current and out-year budgeting. The higher costs for the POES-N' modifications could not be supported by the approved NPOESS out-year budget.

In late August 1998, the IPO and NASA began discussions of an alternative bridging mission, the NPOESS Preparatory Project, to demonstrate early NPOESS operational capabilities and to meet the science needs of NASA's Earth Science Enterprise. In September 1998, the IPO System Program Director and the NASA Associate Administrator for Earth Science directed a joint IPO/NASA team to begin a feasibility study of the NPP mission. Initial planning assumptions included VIIRS, CrIS, and ATMS as the critical three payloads on NPP. However, this did not preclude the NPP team from considering additional payloads. If mass and power margins allow, the IPO/NASA NPP planning team will consider adding a fourth payload to the spacecraft, provided that the program remains affordable and agreements to fund the mission jointly can be negotiated. Potential candidates for this fourth, to-be-determined payload include NASA's Clouds and Earth Radiant Energy System (CERES - also to be flown on NPOESS) and the OMPS.

B: Uncertainties Require Further Alternatives and Cost Analysis

On pages 6 and 7 of the draft inspection report, the OIG states: "The IPO decision that it lacked sufficient funding to fly OMPS may be premature ... [the] IPO learned in December 1998 that it may receive $14.7 million unanticipated funding from Defense. The $14.7 million would be enough to resume the 2002 OMPS delivery schedule." This statement is not accurate.

In FY 1999, the Congressional appropriations for the Department of Commerce reduced NPOESS funding by $14.7 million. The FY 1999 Congressional appropriations for the Department of Defense sustained the request for the NPOESS program at $64.7 million. Because of the $14.7 million

reduction to DOC funding for NPOESS, the IPO had to reduce the projected FY 1999 budget, thereby impacting parts of the program. With the approval of the NPOESS Executive Committee (EXCOM), the IPO eliminated FY 1999 funding for the POES-N' modifications, reduced funding for the Internal Government Studies (IGS) efforts, and reduced funding and stretched out the Phase II production schedules for CrIS, GPSOS, and OMPS instruments. The OMPS delivery schedule was stretched out from 2002 to 2005, when the instrument will be required for integration onto the first NPOESS satellite.

Because the NPOESS program is funded equally by DOC and DOD, it was anticipated that DOD, through the U.S. Air Force, would withhold $14.7 million in FY 1999 and reprogram these funds for other purposes. This withhold did not occur. However, the $14.7 million that was finally released by the U.S. Air Force in early January 1999 was not "unanticipated funding from Defense." The $14.7 million was always a critical part of full funding for NPOESS in FY 1999 to allow the IPO to conduct its budgeted program. If the U.S. Air Force had withheld and reprogrammed the $14.7 million, there would have been further, more serious impacts to the NPOESS program. This additional reduction would have: (1) eliminated the planned upgrades for the Defense Meteorological Satellite Program (DMSP) Multi-spectral Operational Linescan System (MOLS); (2) reduced funding for the Advanced Technology Support Program (ATSP) efforts; and (3) further reduced funding for IGS activities.

Section II: Response to Recommendations

Recommendation 1: Request NASA to include the Ozone Mapper Profiler Suite as a payload alternative in the NPOESS Preparatory Project Mission Concept and Development Plan study.

Response: The Integrated Program Office accepts this recommendation. The Assistant Administrator for Satellite and Information Services, the IPO Acting System Program Director, the NASA Associate Administrator for Earth Science, have directed the joint IPO/NASA NPP planning team to include OMPS as a fourth payload alternative in the NPP mission concept and development plan study. NASA recently released a Request for Information (RFI) to solicit proposals from industry to implement a spacecraft for the proposed NPP mission. The RFI includes mass, power, and data rate specifications for a fourth, instrument-of-opportunity payload on NPP. The planning team will conduct a complete assessment to determine

if a fourth payload, such as OMPS, can be accommodated on NPP within affordable agency cost constraints.

Recommendation 2: Defer the decision to include or exclude OMPS for the NPP flight demonstration until mission costs are fully analyzed and a cost sharing arrangement is negotiated.

Response: The Integrated Program Office accepts this recommendation. A decision on whether a fourth payload can be accommodated on NPP at an affordable program cost, and if so, what that payload will be, will be deferred until NPP mission costs are fully analyzed, IPO and NASA program priorities for NPP are approved by the EXCOM and NASA Headquarters respectively, and an equitable cost sharing arrangement between the IPO and NASA has been negotiated. We expect the NPP study status to be briefed to the EXCOM in the spring of 1999.

Adding a fourth sensor, such as OMPS, to NPP will increase the mass, power, attitude control, command and control, and data transmission requirements that will be placed on the proposed spacecraft. The potential risk is that the NPP mission may not be affordable even with joint IPO/NASA funding, if the spacecraft must be sized and configured to carry four payloads. If a decision is made to carry OMPS as a fourth payload on NPP, then additional funding in the FY 2001 - FY 2004 NOAA budget for NPOESS will be required to accelerate the OMPS instrument fabrication schedule to meet an earlier delivery date for NPP spacecraft integration.

Recommendation 3: Assess the operational risk of not demonstrating OMPS.

Response: The Integrated Program Office accepts this recommendation. Based on a preliminary assessment of information and documentation received from contractors at the recent (January - February 1999) OMPS Preliminary Design Reviews (PDR) in preparation for the Call For Improvement (CFI) proposals, the IPO believes that the contractors' instrument designs are mature enough to be able to accept the potential risk of not conducting a space-based test of the specific OMPS instrument prior to the first operational NPOESS launch, if OMPS cannot be accommodated on the NPP mission. The global ozone mapping component of OMPS will be derived from the TOMS instrument, a proven space-based, remote sensing technology, as well as the improved technologies that will be demonstrated by the Ozone Monitoring Instrument on NASA's CHEM mission beginning in late 2002. The OMPS will also include a limb sensor, rather than a nadir-pointing sensor (e.g., SBUV/2), to improve the vertical resolution in atmospheric

ozone profile measurements. Although this specific sensor has not yet flown operationally, ozone limb sensors have been demonstrated in space in a research mode as early as 1978 on Nimbus-7. Research limb sounders scheduled for flight by NASA over the next several years include: the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) on the Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED) mission in May 2000; and the High Resolution Dynamics Limb Sounder (HIRDLS) on the CHEM mission. These missions will provide valuable risk reduction information to the IPO and its contractors. We will provide a more complete assessment of the potential operational risks of not demonstrating OMPS to the OIG in May 1999, after the IPO has completed source selection and has awarded a single contract for development and fabrication of the OMPS.

We share the OIG's concern about a potential gap in U.S. space-based global ozone mapping capabilities in the 2007 to 2008 time frame, prior to NPOESS. However, this gap may not occur if NASA's CHEM mission is delayed, or if the CHEM mission and the OMI sensor last longer than the planned five year design life. In addition, other ozone mapping sensors (e.g., the Global Ozone Monitoring Experiment [GOME] on the European Organisation for the Exploitation of Meteorological Satellites [EUMETSAT] Meteorological Observation Satellite Series [METOP]) will be available to help maintain the space-based global ozone mapping mission in that time period.

To ensure that a gap in global ozone mapping does not occur in 2007-2008, as the OIG suggests, we believe that NASA, NOAA, and other international partners, such as EUMETSAT, should periodically assess the status of space-based ozone measurements and determine methods to maintain the long-term ozone data record utilizing both space-based and *in situ* observations. This approach will be especially important if the OMPS cannot be accommodated on the NPP mission because of cost considerations and agency priorities.